CLAIMS

Therefore, at least the following is claimed:

1. A digital subscriber line (DSL) transceiver, comprising:

a pulse amplitude modulation (PAM) transmitter;

a fractional encoder associated with the PAM transmitter, the fractional encoder configured to encode a non-integer number of bits for each word to be transmitted by the PAM transmitter; and

a constellation encoder configured to encode each word containing the non-integer number of bits into a signal space constellation to be transmitted by the PAM transmitter, and where each signal space constellation comprises a symbol.

2. The transceiver of claim 1, wherein the signal space constellation is generated by the PAM transmitter.

3. The transceiver of claim 1, wherein the fractional encoder further comprises a modulus converter.

4. The transceiver of claim 1, wherein the fractional encoder further comprises a shell mapper.

5. The transceiver of claim 1, wherein the fractional encoder further comprises a constellation switcher.

6. The transceiver of claim 1, wherein each symbol is transmitted using a single dimensional signal space constellation.

7. The transceiver of claim 1, wherein each symbol is transmitted using a multi-dimensional signal space constellation.

8. The transceiver of claim 1, further comprising a trellis encoder associated with the constellation encoder.

9. The transceiver of claim 1, wherein the fractional encoder is configured to collect an integer number of bits S*K, over a frame comprising several symbol periods S, and is configured to encode the frame of S*K bits for transmission at a fractional bit rate of K bits per symbol.

10. The transceiver of claim 9, wherein the fractional encoder is configured to convert the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels.

11. The transceiver of claim 1, further comprising a fractional decoder configured to decode a received symbol into a non-integer number of bits.

12. The transceiver of claim 11, wherein the fractional decoder is a modulus converter.

13. A method for encoding fractional bit rates using pulse amplitude modulation (PAM), the method comprising the steps of:

providing a PAM modulator;

using the PAM modulator to generate a transmit signal; and

encoding the transmit signal with a modulation symbol representing a non-integer number of bits, wherein the sum of the bits over a plurality of symbol times results in an integer number of bits.

14. The method of claim 13, wherein the encoding step includes modulus conversion.

15. The method of claim 13, wherein the encoding step includes shell mapping.

16. The method of claim 13, wherein the encoding step includes constellation switching.

17. The method of claim 13, wherein the modulation symbol is encoded into a multi-dimensional signal space constellation.

18. The method of claim 13, wherein the modulation symbol is encoded into a single dimensional signal space constellation.

19. The method of claim 13, further comprising the step of trellis encoding the modulation symbol.

20. The method of claim 13, further comprising the steps of:

collecting an integer number of bits S*K, over a frame comprising several symbol periods S; and

encoding the frame of S*K bits for transmission at a fractional bit rate of K bits per symbol.

21. The method of claim 20, further comprising the step of converting the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels.

22. A digital subscriber line (DSL) transceiver, comprising:

means for providing a PAM modulator;

means for using the PAM modulator to generate a transmit signal, the transmit signal including a plurality of transmit symbols; and

means for encoding each of the transmit symbols with a non-integer number of bits, wherein the sum of the bits over a plurality of transmit symbols results in an integer number of bits.

23. The transceiver of claim 22, wherein the encoding means includes modulus conversion means.

24. The transceiver of claim 22, wherein the encoding means includes shell mapping means.

25. The transceiver of claim 22, wherein the encoding means includes constellation switching means.

26. The transceiver of claim 22, wherein the transmit symbol is encoded into a single dimensional signal space constellation.

27. The transceiver of claim 22, wherein the transmit symbol is encoded into a multi-dimensional signal space constellation.

28. The transceiver of claim 22, further comprising means for trellis encoding each of the transmit symbols.

29. The transceiver of claim 22, further comprising:

means for collecting an integer number of bits S*K, over a frame comprising several symbol periods S; and

means for encoding the frame of S*K bits for transmission at a fractional bit rate of K bits per symbol.

30. The transceiver of claim 29, further comprising:

means for converting the S*K bits of the frame into S integers, each of arithmetic base M, where M corresponds to a plurality of PAM signal levels.